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Nidula shingbaensis sp. nov., a new bird's nest fungus from India

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Abstract —A new species of bird's nest fungi, *Nidula shingbaensis,* is proposed from the state of Sikkim. It is characterised by a slightly flared moderate to large peridium, yellowish interior peridium-wall, numerous brown-coloured peridioles with irregularly wrinkled surfaces, large broadly ellipsoid to elongate basidiospores, and a six-layered (in cross-section) peridium. A detailed description is supported by macro- and micromorphological illustrations, and the relation with similar and related taxa is discussed.

Key words — *Basidiomycota*, macrofungi, *Agaricaceae*, *Agaricales*, taxonomy

Introduction

Bird's nest fungi, previously placed in a separate family *Nidulariaceae*, were recently moved to the *Agaricaceae* (Kirk et al. 2008). Currently, they are represented in India by three genera with 17 species (14 *Cyathus* spp., *Nidula emodensis*, *N. candida,* and one *Crucibulum* sp.; Das & Zhao 2012).

Shingba Rhododendron Sanctuary (43 km^2) lies in the North district of Sikkim (a small Indian state in the eastern Himalaya). This subalpine area in the Yumthang valley and surroundings is covered by over 40 *Rhododendron* species but otherwise dominated by trees (*Abies densa*, *Picea spinulosa*, *Tsuga dumosa*, *Larix griffithii*, *Magnolia globosa*, *M. campbellii*, *Acer pectinatum*, *Betula utilis*) and harbours abundant macrofungi. During a 2011 macrofungal survey, the senior author came across a striking bird's nest fungus, which, after thorough macro- and micromorphological studies and literature surveys, we propose here as a new species, *Nidula shingbaensis*. We offer a detailed description and illustrations, discuss the relationship of the new species with allied Indian and extralimital taxa, and provide a provisional key to all species of *Nidula*.

Materials & methods

Macromorphological characters were recorded from the fresh basidiomata in the field and in the base camp. Field photographs of the fresh basidiomata were taken with the aid of Nikon D300s. Colour codes and terms (mostly) are as in the Colour identification chart of British Fungus Flora (Henderson et al. 1969). Immediately after recording the macromorphological characters, basidiomata were dried with a field drier.

In the laboratory, macromorphological characters were again observed from the dry samples with the help of stereo zoom dissecting microscope Nikon SMZ 1500 and photographs were taken through the attached dedicated camera. Other micromorphological structures such as basidiospores, cross-sections of peridium and peridiole were noted with the aid of light microscope Nikon E 50i and photography was made with the attached dedicated camera based on the free-hand sections from dry samples mounted in a mixture of 5 % KOH, 30 % glycerol, phloxine and cotton blue. Spore measurements are noted based on twenty basidiospores. Spore size measurements and length/width ratios (Q) are presented as: minimum–**mean**–maximum. Herbaria names are after Holmgren et al. 1990.

Taxonomy

Nidula shingbaensis K. Das & R.L. Zhao, **sp. nov.** Plates 1–2

MycoBank: MB 803499

Differs from all other *Nidula* species by its six-layered peridium.

Type: India. Sikkim: North District, Shingba Rhododendron Sanctuary, 27°43′28.1″N 88°44′53.8″E, alt. 2997 m, 24.VIII.2011, K. Das, KD-11-76 (**Holotype**, BSHC; GenBank KC763972. **Isotype**, SWFC).

Etymology: after Shingba Rhododendron Sanctuary, the type locality

Basidiomata urn- or vase-shaped, 6–9 mm high (≤11 mm high with epiphragm/lid), 5–7 mm wide at mouth, gradually tapering towards base (up to 4 mm wide), sessile. Epiphragm operculate, buff (52), rupturing at maturity. Exterior of the peridium distinctly matted fibrillose to villose, or wooly, hairs mostly in tufts (≤230 μm high), white to buff or clay pink; mouth slightly flared, margin straight to recurved, fringed, white (1A1), never wooly, never split into stellate lobes. Interior of the peridium smooth (never plicate), never shining, saffron (49) to pale yellow (3C) towards mouth, rust or darker towards base. Peridioles numerous (≤40), 0.9–1.3 mm in diam., lenticular, surface irregularly wrinkled, very sticky, embedded in transparent mucilaginous gel when moist, cinnamon (10), snuff brown (17) to cigar brown (16); funiculus absent.

Peridium 650–720 μm thick (excluding hair), comprising six layers. Four outer layers composed of loose hyphal mats, "intricata" textura; each layered separated by a cord of grouped hyphae; the four (from the outermost) are 210 μm, 80 μm, <85 μm, and <120 μm thick; hyphae 3.5–5 μm wide, thick-walled (wall ≤2 μm thick), with clamp connections, hyaline to greenish yellow in KOH.

Plate 1: *Nidula shingbaensis* (Holotype KD-11-76). A, E. Basidiomata attached on substrates showing epiphragm and peridioles; B. Exterior of peridium (from dry sample); C. Peridium showing flared mouth and peridioles; D. Peridioles with wrinkled surface; F. Longitudinal section of peridium showing the interior (from dry sample). Scale bars: B, C, F = 1 mm; D = 0.5 mm.

Two inner layers of very similar nature, comparatively compact, placed above the internal (inner most) edge of disintegrated hyphae; the outermost is <90 µm and the innermost <190 µm thick. Hairs (≤70 µm wide at base) originating

from hyphal cord, passing through two or three outer layers projected beyond (emergent) the outer most layer ≤230 µm. Peridioles three layered (cortex, subcortex and hymenium), covered with tunica (≤27 µm thick); cortex ≤48 µm thick, two layered, consisting of an exocortex with hyphal tips (hyphae ≤2.2 µm wide) projecting in tunica, blue (72) in cotton blue and an endocortex with branched aseptate slightly to very thick-walled (≤4 µm thick) grayish yellow to rust (13) or rusty tawny (14) hyphae (≤10 µm wide); subcortex thick (≤120 µm), yellowish brown to cinnamon in cotton blue, subhyaline towards hymenium, with very thick-walled (wall ≤8 µm thick) hyphae having narrow lumen, bluish with cotton blue; hymenium ≤145 µm thick, subhyaline, blue in cotton blue, containing spore mass and hyphae (≤2 µm wide). Capillitium absent. Basidia not found (in mature peridioles). Basidiospores 6.9–**8.3**–9.8 × 4.9–**5.4**–6.1 µm, broadly ellipsoid to elongate (Q = 1.25–**1.52**–1.88), mostly rounded at both ends or at least at one end, thick-walled (≤1 µm thick), subhyaline, contents blue in cotton blue, hyaline to greenish yellow (inamyloid) in Melzer's reagent and pink in phloxine.

Ecology & Distribution — Gregarious to caespitose on small fallen twigs of *Abies densa* Griff. in subalpine coniferous or mixed forest. August. Rare.

Additional specimen examined: **India**. **Sikkim**: North District, Shingba Rhododendron Sanctuary, 27°43′48.6″N 88°44′32.0″E, alt. 3095 m, 25.VIII.2011, K. Das, KD-11-92 (BSHC).

Notes — Its morphological characters (urn- to vase-shaped basidiomata containing numerous lenticular brown peridioles, six-layered peridium, mouth with epiphragm/lid, presence of tunica on the peridioles, two-layered cortex enclosing basidia and basidiospores, absence of capillitium and presence of smooth, hyaline, broadly ellipsoid to elongate basidiospores) easily place the present species amongst bird's nest fungi. Moreover, the presence of a multi-layered peridium with epiphragm/lid, absence of funiculus, and presence of transparent mucilaginous gel surrounding the peridioles confirms its placement in *Nidula* (Brodie 1975; Miller & Miller 1988).

Nidula shingbaensis is distinguished by its moderate to large peridium (6–9 × 5–7 mm), yellowish interior peridium-wall, brown-coloured large (0.9–1.3 mm diam.) peridioles with irregularly wrinkled surface, broadly ellipsoid to elongate large (6.9–9.8 × 4.9–6.1 µm) basidiospores, and six-layered peridium (in cross-section).

Macroscopically the new species is quite similar to three other *Nidula* species: *N. emodensis* (Berk.) Lloyd (Berkeley 1854; Cunningham 1924), *N. candida* (Peck) V.S. White (Brodie 1975; Das & Zhao 2012) and *N. macrocarpa* Lloyd (Lloyd 1917). However, *N. emodensis* differs in its smaller (4–6 mm high) peridia and relatively small (0.5–1 mm diam.) peridioles that are almost black at maturity (Cunningham 1924). *Nidula candida* differs by the larger peridium

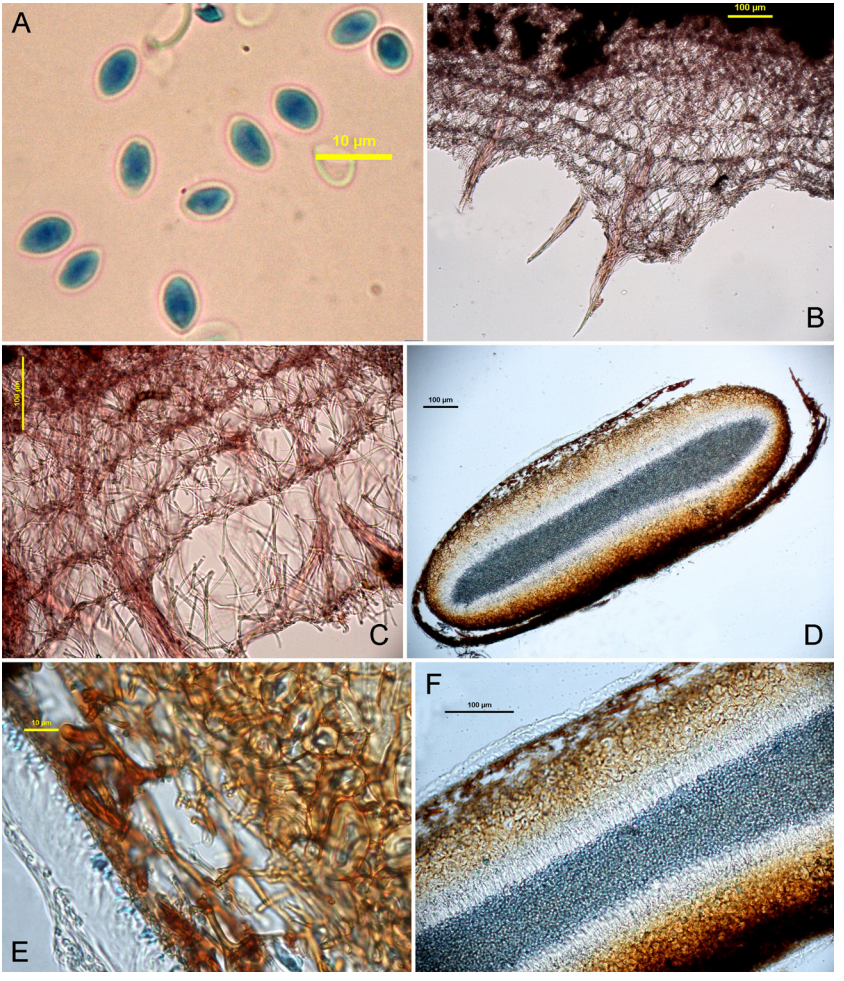

Plate 2: *Nidula shingbaensis* (Holotype KD-11-76). A. Basidiospores; B. Cross-section of peridium showing six layers; C. Four loose outer layers of peridium; D, F. Cross-section of peridiole showing tunica, cortex, subcortex and hymenium (blue), E. Transverse-section of peridiole showing tunica covering two layered cortex and subcortex. Scale bars: A, E = 10 µm; B–D, F = 100 µm.

(8–13 mm high) with more flared mouth and larger peridioles (1.5–1.8 mm diam.; Das & Zhao 2012). Similarly, *N. macrocarpa* (reported from Argentina and Chile) can be separated from *N. shingbaensis* by its small (0.5–1 mm diam.) peridioles and single layered peridium in cross-section (Diehl 2000). Finally, another species, *N. niveotomentosa* (Henn.) Lloyd (reported from North

America), differs from *N. shingbaensis* by its shorter peridium (5–7 mm high) and smaller peridioles (0.5–1 mm diam.; Miller & Miller 2006).

A provisional key to *Nidula* species

1. Basidiomata large, often ≥ 10 mm high 2
1. Basidiomata small, always <10 mm high 3
2. Peridioles 1.5–3 mm diam.; basidiospores 8–10 × 4–6 μm. . . . . *N. candida*
2. Peridioles 0.5–1.0 mm diam.; basidiospores 12–16 × 5–6 μm . . . . . *N. macrocarpa*
3. Exterior of peridium dingy grey; peridioles almost black at maturity. . . *N. emodensis*
3. Exterior of peridium white to yellowish or buff; peridioles reddish brown to grey, never black. 4
4. Peridioles 0.5–1.0 mm diam.; peridium 2–3-layered . . . . . *N. niveotomentosa*
4. Peridioles 0.9–1.3 mm diam.; peridium 6-layered . . . . . *N. shingbaensis*

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